

Kyushu Matsushita Electric Co., Ltd. Telecom Div.

1-62, 4-chome, Minoshima, Hakataku, Fukuoka 812-8531, Japan

TEL (092) 477-1433 FAX: (092) 477-1646

Report No.: KMTD(ENG)-02-001

Date: March 26, 2002

**TEST REPORT
AND
ANALYSIS/EVALUATION**

REGULATION : FCC 15.247(E)

PRODUCT : Direct Sequence Spread Spectrum Cordless Telephone

MODEL NO. : KX-TG2584

FCC ID : ACJ96NKX-TG2584

SERIAL NO. : Prototype

TEST DATE : March 25, 2002

JUDGEMENT: Passed FCC 15.247(e) Processing Gain Requirement

Tested by : N. Nakano
Nobutoyo Nakano
Engineer of Engineering
1 Team

Approved by: 大石 雄三
Yuhzoh Ohishi
Manager of Engineering
1 Team

NOTE: The test results shown on this report are only for the tested sample. It is not allowed to make a copy of this report, even a part, without our allowance. Kyushu Matsushita Electric Co., Ltd. Telecom Div. accepts no responsibility for any damage caused by such a usage.

Requirements

According to the FCC requirement 15.247(e) for direct sequence spread spectrum systems, the minimum processing gain is 10 dB. The CW jamming margin method was used to determine the KX-TG2584 processing gain. The processing gain was calculated using the following equation:

$$G_p = (S/N)_o + M_j + L_{sys} \text{ where:}$$

G_p = Processing Gain

$(S/N)_o$ = Signal to noise required for a given error probability. In this case 1×10^{-4} was used.

M_j = J/S Jammer to signal ratio required to produce given error probability.

L_{sys} = System losses to due non-ideal performance. Maximum allowed by the FCC is 2.0 dB.

The $(S/N)_o$ ratio was determined to be 11.0 dB according to Jakes "Microwave Mobile Communications". Page 229 indicates the relevant curve showing error probability Vs $(S/N)_o$ for a non-coherent FM system with a peak deviation equal to .35 of the modulation frequency:
 $F_d = .35 F_s$.

Given a minimum processing gain of 10 dB, the minimum allowable J/S ratio is -3.0 dB.

I. Test Setup

The processing gain was measured using the test setup shown in Figure 1:

The following test equipment was used for this setup:

- KX-TG2584 (Equipment under test)
- Dummy Set: Used KX-TG2584 evaluation set.
- IFR 2051 Signal Generator (for desire signal)
- Hewlett Packard ESG D3000A Signal Generator (for jamming signal)
- Taisei SPL1141 Coupler
- Japan Radio Co Ltd.(JRC) NJZ-940 TDMA Error Ratio Measuring Equipment (BER tester)
- Semiflex SMA cables

The Dummy Set was set up at the middle channel 2.4345 GHz. The KX-TG2584 base band 3dB bandwidth is less than 1.0 MHz; therefore, the signal generator was used to inject a CW jammer from 2.4335 GHz to 2.4355 GHz in 50 kHz increments. The DUT received input power was set at -70 dBm. The jammer power was adjusted to achieve a bit error rate of 1×10^{-4} at each jammer frequency. The jammer power was recorded and the processing gain calculated for each jammer frequency from 2.4335 GHz to 2.4355 GHz.

II. Test Results

The processing gain Vs jammer frequency is shown in Figure 2 and Figure 3 :

$$G_p = (C/N)_0 + M_j + L_{sys}$$

G_p = KX-TG2584 Process Gain
 $(S/N)_0$ = S/N ratio for keeping $BER=1 \times 10^{-4}$
 $(S/N)_0$ is 11dB on this system.
 M_j = J/S ratio (CW Jamming margin method)
 L_{sys} = system loss (≤ 2.0 dB)

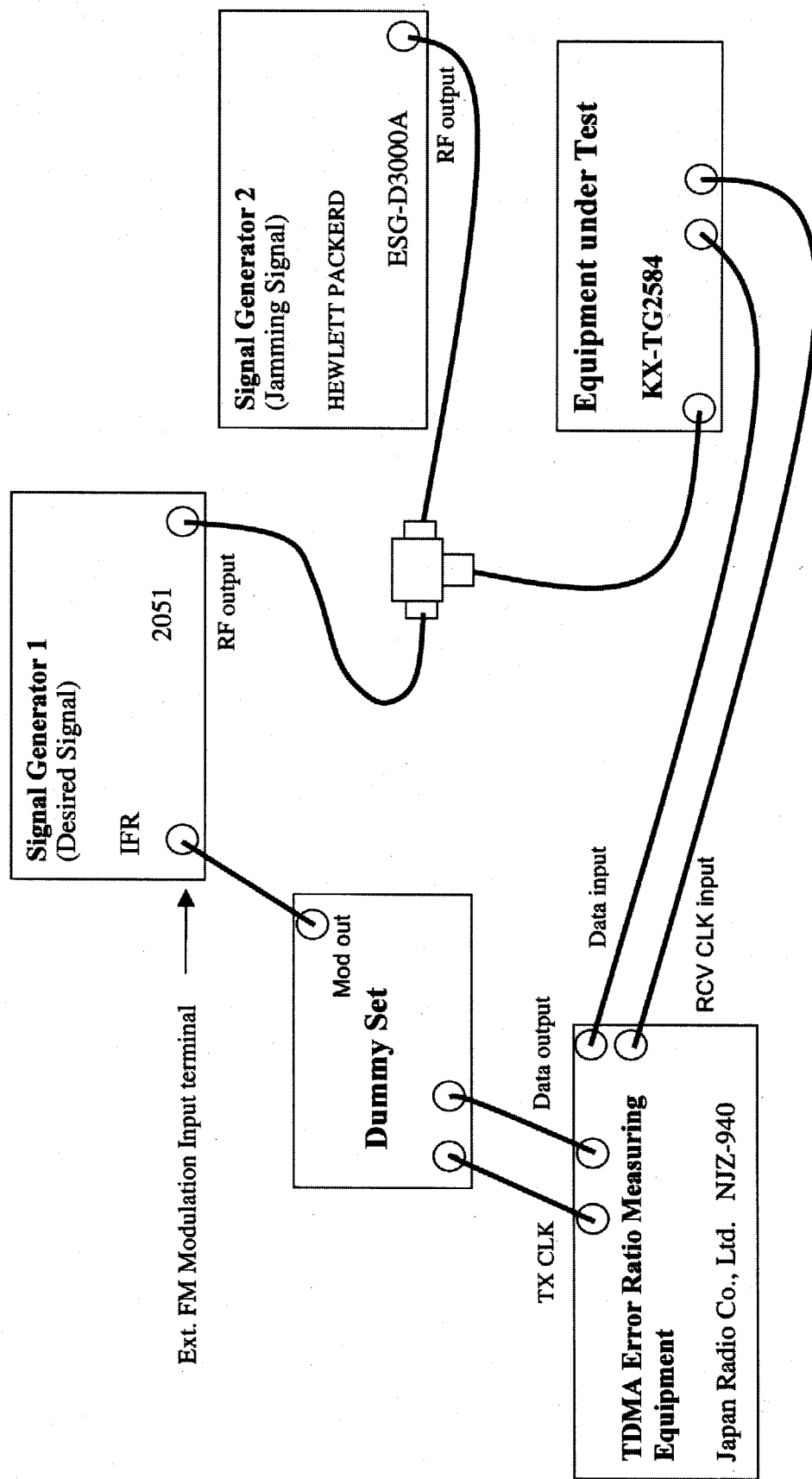


Figure 1: Processing Gain Test Setup

KX-TG2584 Processing Gain Test Results

Kyushu Matsushita Electric Co., Ltd.
Engineering 1Team
Telephone Engineering Department/
Telecom Division

N.Nakano

Δf (kHz)	KX-TG2584 -H J/S Ratio (dB)
1000	8.6
950	6.4
900	4.4
850	2.8
800	2.0
750	-0.3
700	-1.2
650	-1.6
600	-1.6
550	-1.5
500	-1.3
450	-1.4
400	-1.0
350	-1.2
300	-1.0
250	-0.9
200	-0.8
150	-0.6
100	-1.1
50	-0.5
0	0.1
-50	0.2
-100	-0.9
-150	-0.8
-200	-1.0
-250	-0.8
-300	-0.9
-350	-1.3
-400	-1.3
-450	-1.4
-500	-1.6
-550	-1.5
-600	-1.7
-650	-1.8
-700	-1.6
-750	-1.2
-800	-0.2
-850	1.0
-900	4.0
-950	5.3
-1000	8.3

J/S Ratio = (Jammer Signal) / (Desired Signal) Ratio



= worst 20% points

These points are excluded.

Mj Jamming Margin

Mj(J/S ratio)	
Base	-1.4dB

Note: Mj level is worst value
after exclude worst 20% points.

Process Gain

$$G_p = (S/N)_o + M_j + L_{sys}$$

$$(S/N)_o = 11\text{dB}$$

$$L_{sys} = 2.0\text{dB}$$

Mj: compare above table.

Gp (Process Gain)	
Base	11.6dB

$$(-1.4 + 11 + 2)$$

Figure 2: Test Results of Process Gain

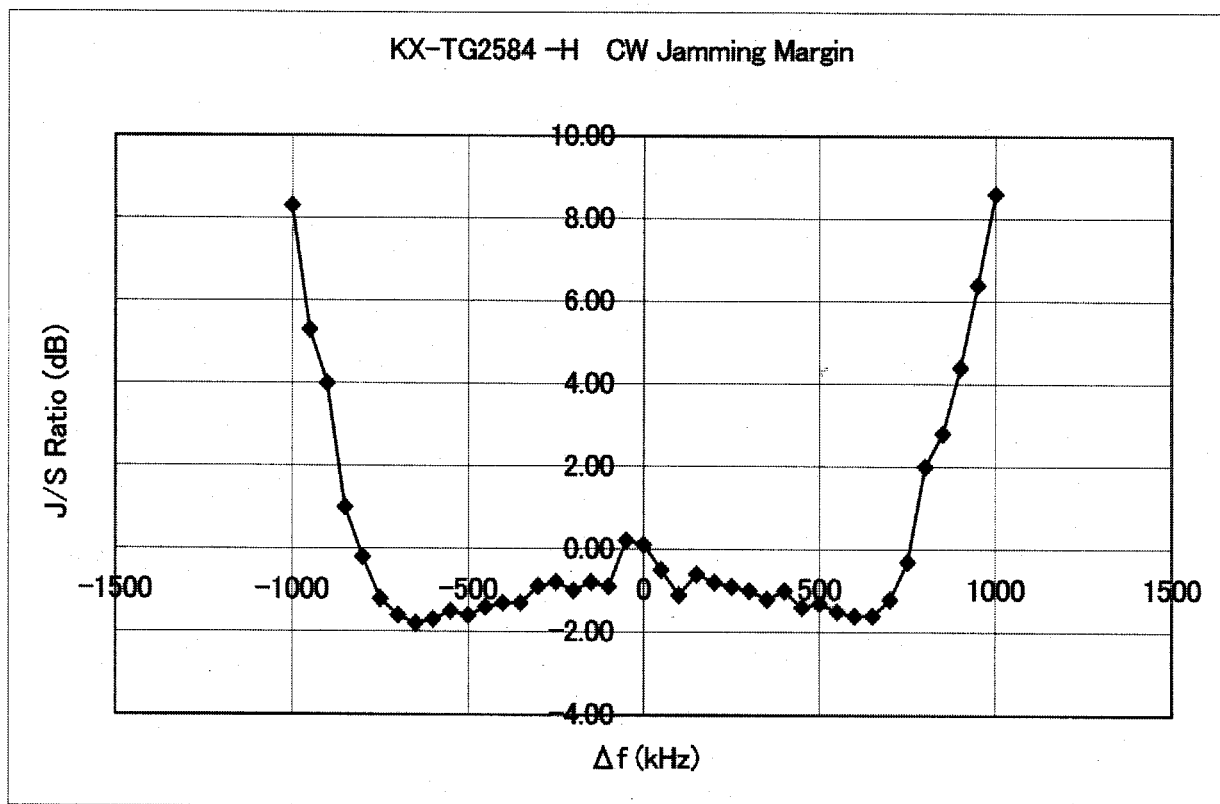


Figure 3: Test Results of Jamming Margin

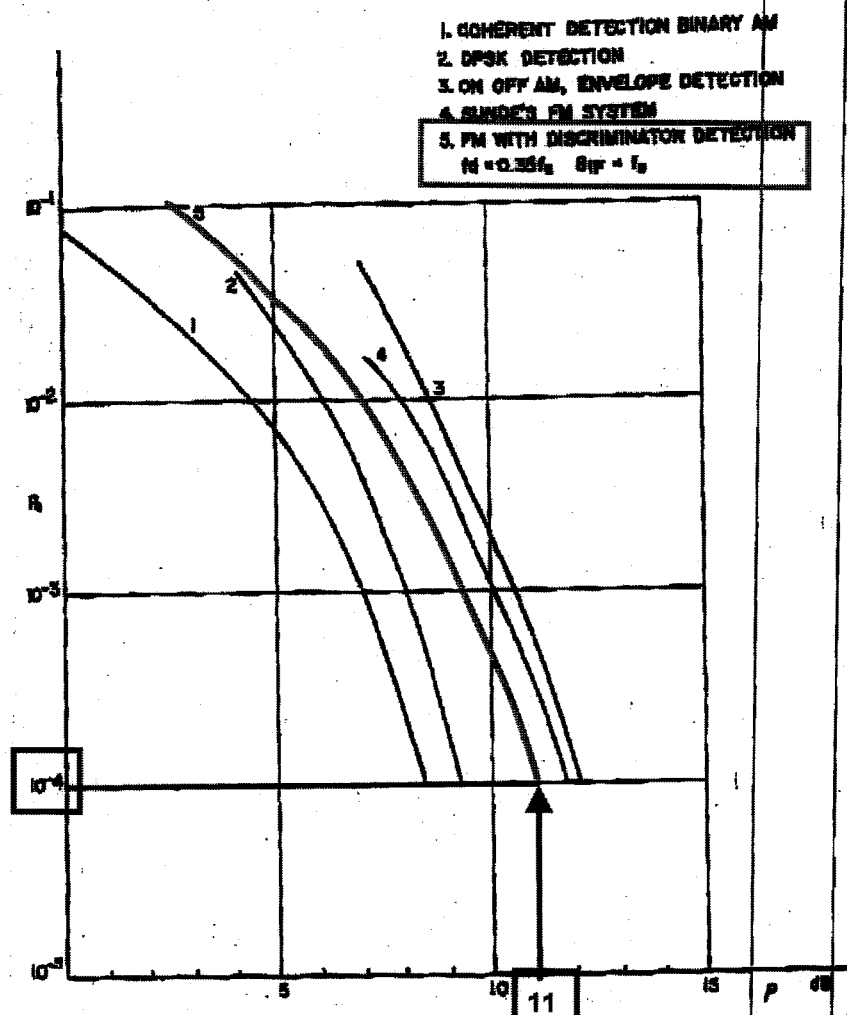


Figure 4.2-6 Error rate as a function of average transmitter power to noise ratio, $p = P_T/N_{w_0}$.

The peak frequency deviation is f_d . It is clear that $x(t)$ is no longer band limited. Calculations show^{31, 32} that for small deviations, that is, $f_d < f_c/4$, the spectrum of $x(t)$ is essentially contained in a narrow RF bandwidth of $1.5 f_c$. A narrow-band system has been described by Sahr^{32, 33} with $f_d = f_c/4$ and a bandwidth of $1.5 f_c$. The transmitted wave was no longer strictly FM but had small amplitude fluctuations. With conventional limiter discrim-